NON-PUBLIC?: N
ACCESSION #: 9011080128
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Brunswick Steam Electric Plant Unit 2 PAGE: 2 OF 6

DOCKET NUMBER: 05000324

TITLE: Scram Caused by Failure of the Start-up Level Control Valve
Resuling in Low Level RPS Actuation.
EVENT DATE: 08/30/90 LER #: 90-012-01 REPORT DATE: 11/01/90

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 2 POWER LEVEL: 008

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: SJ COMPONENT: LCV MANUFACTURER: F127
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On August 30, 1990, Unit 2 reactor start-up was in progress. The reactor was at approximately 8% power and 300 psig. The Emergency Core Cooling Systems were operable in standby line up except for the High Pressure Coolant Injection System which was inoperable awaiting the performance of the HPCI System Operability Test. At 1656 the start-up level control valve (SULCV) failed closed resulting in a level transient. At 1657 the Reactor Protection System (RPS) low level #1 setpoint (165") was reached causing a reactor scram. Primary Containment Isolation System groups 2, 6 and 8 also received an isolation signal and actuated per design. Scram recovery was in accordance with the emergency flowcharts and procedures. Approximately 20 minutes after the scram, level was stabilized. The cause of the SULCV failure is believed to be worn o-ring seals. The seals have been replaced and the SULCv is operating properly. The worn

seals are being analyzed to determine the cause of the failure. The safety significance of this event is minimal. Level was recovered without the need for safety system injection and the unit is designed for a level transient from full power.

END OF ABSTRACT

EVENT

During a Unit 2 start-up on August 30, 1990, the Start-up Level Control Valve (SULCV) failed closed resulting in a reactor scram on low level.

INITIAL CONDITIONS

On August 30, 1990, a Unit 2 reactor start-up was in progress following the SCRAM on August 19, 1990 (reported in LER 2-90-009). The Emergency Core Cooling Systems (ECCS) were operable in standby line up except for the High Pressure Coolant Injection (HPCI) system which was in standby, awaiting the performance of periodic test (PT) 09.2, HPCI System Operability Test. The "B" reactor feed pump (RFP) was in service and reactor pressure was being increased to rated (1000 psi), in accordance with site procedures. The reactor was at approximately 8% power and 300 psi. Reactor level was 188 inches. Prior to the event, the start-up level control valve (SULCV) had been operating properly in automatic, for approximately twelve hours, with a 60 - 80% demand signal. Additional coolant inventory was being supplied by the cooling water flow to the control rod drives from the control rod drive (CRD) system. The Reactor Water Cleanup (RWCU) system was in service and being rejected to the condenser. Operations was in the process of placing the "B" Reactor Water Cleanup (RWCU) system filter demineralizer in service and was monitoring reactor level closely. At approximately 1615, reactor level began to increase.

EVENT DESCRIPTION

At 1619, the high reactor level alarm annunciated. At 1628, it was noted that the demand signal to the SULCV had decreased to 20%, indicating that the SULCV circuitry did sense the increasing level and was attempting to throttle the valve closed and decrease level. The reactor operator (RO) took manual control of the SULCV and decreased the demand signal to zero. With a closed signal to the SULCV the valve remained open, as indicated by flow through the feedwater (FW) V177 valve. (The FW-V177 is located downstream of the SULCV and, by procedure, is utilized in conjunction

with it to maintain vessel level by diverting flow to the condenser.) An auxiliary operator (AO) was dispatched to locally verify the actual position of the SULCV. By maximizing the RWCU reject and

minimizing the CRD cooling water flow, the RO was able to stabilize and terminate the vessel level increase at approximately 207 inches. At 1640, vessel level was beginning to slowly decrease. At approximately 1650, the AO reported that the SULCV was full open. At 1653, the AO noted an audible change in the flow rate through the SULCV and observed that the valve had gone full closed. He immediately notified the control room. Coincident with the closure of the SULCV, level began to rapidly decrease at approximately 13 inches per minute. At 1654, the reactor low level alarm was received. At 1655, the SULCV bypass valve, V120, was partially opened by the RO. At 16:55:28, reactor level returned to normal and began to increase at approximately 34 inches a minute. Five seconds later, the Average Power Range monitor (APRM) upscale rod block annunciator alarmed because of the increased reactivity caused by the cold water injection. Peak power was approximately 12%. Seven seconds later the reactor high level alarm was received. At 16:55:45, the FW-V177 was opened further to reduce the coolant injection rate and the level increase was terminated. At 16:55:54, level has returned to within the normal operating range but was decreasing at approximately 13 inches per minute. At 16:56:54, level reached the low level alarm setpoint. The RO attempted to close the FW-V177 but the level decrease continued. At 16:57:56, the Reactor Protection System (RPS) low level one setpoint was reached, resulting in a SCRAM and Primary Containment Isolation System (PCIS) groups 2, 6, and 8 isolations, as designed. SCRAM recovery was in accordance with site Emergency Operating Procedures (EOPs). The lowest level during the event was 135 inches. The SULCV bypass did not respond when attempts were made to open it further and the Shift Foreman directed that the Number 4 and 5 feedwater heater inlet valve (V119) be partially opened. Reactor level began to climb. A balance between V119 and the V177 could not be reached and level climbed to the high level turbine trip point. Another attempt to balance level utilizing the V120, V119 and V177 was unsuccessful and the vessel was overfed. The feedwater inlet valves were closed and, at 1719, level control was established utilizing the CRD cooling water flow and RWCU reject flow.

EVENT INVESTIGATION

After the event, a local inspection of the SULCV found an air leak on the supply line to the valve positioner which is mounted on top of the valve actuator. The leak was caused by a fractured air line adjacent to a tubing fitting. The break was evidently caused by

fatigue from excessive line movement due to flow induced vibration (ie, possibly during the event). The hardware which secured the line in place was found in the area near the valve. It is not believed that this caused the SULCV to fail open because the valve is equipped with a relay trip valve to fail the valve closed on a loss of air supply. Troubleshooting showed that the SULCV opened further with a constant demand signal to the valve and increasing air leakage. The valve was given a 80% open demand signal and went to about 90% open with the existing leak. As the leak was increased, the valve opened further. When the demand signal was reduced to 0% the valve shut slowly, to approximately 50%, then quickly, as the relay trip valve actuated. The test was repeated twice with similar results. Actual conditions present during the event could not be reproduced because the SULCV vibrates significantly with water flowing through it and there was no flow at the time of the testing. In addition, the magnitude, and changes in the magnitude, of the air leak throughout the event are not known.

Further testing, with the air line tubing repaired, resulted in the observation that the SULCV stayed full open regardless of the demand signal, indicating that other problems existed. Subsequent removal of the positioner air supply actuated the relay trip valve and caused rapid closure of the SULCV. The control loop, up to the valve positioner, was inspected and verified to be operating properly, indicating that the valve positioner may have been malfunctioning. The positioner was inspected and determined to be for a four inch stroke actuator instead of the desired five inch. Its range spring was found to be severely stretched. This would have affected the feedback mechanism of the positioner, however, it is believed that the positioner problems were not related to the SULCV failure because the positioner had operated since its installation a few years prior, stroked correctly in the month preceding the event and during the original SULCV troubleshooting efforts. After replacing the positioner with one of the correct size, further sticking was noted. Some regions of demand controlled properly, but the valve would stick in the full open position. The positioner was again replaced, and similar effects were noted. Trouble shooting then focused on the valve actuator.

The SULCV actuator is a piston type actuator without springs. Actuator travel occurs when a differential pressure is applied across the piston. The actuator stem moves up when the bottom cylinder pressure is greater than the top cylinder pressure. The

actuator stem moves down when the top cylinder pressure is greater than the bottom cylinder pressure. When the top and bottom cylinder pressures are equal or balanced, the actuator stem does not move. With the supply air connected directly to the actuator, the valve opened properly but would stick in the open position. When the valve was sticking, air was blowing from the vented side of the actuator, indicating piston seal leakage. A technical representative assisted with repairs to the actuator. It was disassembled and the o-ring seals of the main piston seal were found to be squared off and the upper shaft seals were found to be hard/broken. The o-rings were replaced and the SULCV operated properly. The worn seals are believed to be the cause of the event because the SULCV still responded in a manner similar to its response during the event (ie, stuck open) after the air leak and positioner repairs were complete. However, after the o-ring seals were replaced the SULCV responded properly. Past similar events involving the SULCV include 2-90-009 and 2-88-019 but neither of the events were related to worn o-ring seals.

ROOT CAUSE

The failure of the SULCV to respond to a demand signal from its controller is believed to have been caused by the worn actuator seals.

CORRECTIVE ACTIONS

The o-ring seals were replaced and the SULCV was functionally tested prior to start-up of Unit 2. It was found to be operating properly.

The worn o-ring seals are being analyzed to determine the cause of failure.

The SULCV on Unit 1 will be checked for worn seals, air leaks, control loop drift and the proper positioner during the current refueling outage. The air supply to the SULCV will be isolated from valve vibration on both units by using flexible air lines between the actuators and the supply air tubing.

EVENT ASSESSMENT

The safety significance of this event is minimal. The plant is analyzed for a loss of feedwater flow and responded as designed. During the event, the ECCS systems were not required to actuate and level was restored utilizing balance of plant equipment.

EIIS CODES

COMPONENT EIIS

SULCV SJ/LCV
HPCI BJ
RFP SJ/P
CRD AA
RWCU CE
V177 SJ/V
V120 SJ/V
V119 SJ/ISV

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ATTN: Document Control Desk
Washington, D. C. 20555

BRUNSWICK STEAM ELECTRIC PLANT UNIT 2
DOCKET NO. 50-324
LICENSE NO. DPR-62
SUPPLEMENTAL LICENSEE EVENT REPORT 2-90-012

Gentlemen:

In accordance with Title 10 of the Code of Federal Regulations, the enclosed Supplemental Licensee Event Report is submitted. The original report fulfilled the requirement for a written report within thirty (30) days of a reportable occurrence and was submitted in accordance with the format set forth in NUREG-1022, September 1983.

Very truly yours,

J. L. Harness, General Manager

Brunswick Nuclear Project

TMJ/

Enclosure

cc: Mr. S. D. Ebneter
Mr. N. B. Le
BSEP NRC Resident Office

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